# Foreign Bank Entry, Bank Efficiency and Market Power in Central and Eastern European Countries *

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February 13, 2009

**Abstract**

This paper analyzes the implications of the recently observed sharp expansion of foreign banks to the Central and Easter European Countries (CEECs). Using a simple intermediation model, we show that the mode of foreign entry has a pivotal impact on the post-entry performance of banks in CEECs. Foreign greenfield banks are characterized by a superior cost efficiency, compared to domestic and foreign acquired banks. The efficiency of foreign acquired banks deteriorates in the initial year of acquisition, but improves thereafter. Banks acquired by foreigners have less market power relative to the rest of the banking system, while the impact of foreign greenfield entry on market power is insignificant. Overall, CEECs banking sectors have benefited from the increased foreign bank participation, both in terms of higher efficiency and more competition.

KEYWORDS: foreign bank entry, bank efficiency, market power

JEL CLASSIFICATION: C30, E44, F21, G21

*The work on this paper was supported by an individual grant number R07-1181 from the Economics Education and Research Consortium, Inc. (EERC), with funds provided by the Eurasia Foundation (with funding from the US Agency for International Development), the World Bank Institution, the Global Development Network and the Government of Sweden. We would like to thank Isabel Schnabel, Michael Beenstock, Richard Ericson, Dirk Krueger, two anonymous referees and participants of the EERC Research Workshop for useful comments and suggestions. We are grateful to Emilia Jurzyk and Iman Van Lelyveld for kindly sharing their data. The usual disclaimer applies.

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# 1 Introduction

During the last two decades, one of the most remarkable developments in international banking has been the sharp increase of foreign bank participation in Central and Eastern European countries (CEECs). The average market share of foreign-owned banks in 11 CEECs has grown from 14% in 1995 to 80% in 2006 (see Figure 1), which is the largest increase of foreign bank participation in emerging markets (IMF, 2000). At present, foreign banks account for a dominant share of assets in most of CEECs (except for Slovenia), in some cases reaching the staggering level of more than 90%. This pattern of foreign bank participation is in contrast to developments in industrial countries, where cross-border bank expansion is rare (Buch and DeLong, 2004).[1] Naturally, it raises the question to what extent foreign bank entry benefits banks and their customers in CEECs.

Theoretically, the increased foreign bank participation can affect domestic markets via increased market competition and improved banking performance due to spillover effects (Lehner and Schnitzer, 2008). The mode of foreign bank entry (greenfield investments versus cross-border acquisitions) plays a crucial role in the transmission of benefits to domestic customers (Claeys and Hainz, 2007). As opposed to cross-border acquisition, a greenfield entry increases the total number of banks, inducing more competition. On the other hand, the primary motivation for the greenfield investment is usually to follow clients of the bank abroad (Aliber, 1984), which might alleviate the effect of foreign entry on competition. Similarly, the performance of foreign banks in emerging economies constitutes a trade-off. While foreign banks entering the market have lower refinancing costs, host country banks have superior information about the quality of domestic borrowers (Dell'Ariccia and Marquez, 2004).

Empirical literature provides mixed evidence on the impact of foreign bank entry on the performance and competitiveness of banking systems in host countries. Claessens et al. (2001) report that foreign bank entry leads to more competitive pressure and higher efficiency of banks in the host country, implying positive welfare effects for economies liberalizing their banking markets. However, this result holds only for the case of developing countries, while the conclusions are reversed when considering foreign bank entry into developed economies. For the case of CEECs, the impact of foreign bank participation on the performance measured by cost efficiency is also mixed. Single-country studies on Croatia (Jemrić and Vujčić, 2002), Hungary (Hasan and Marton, 2003) and Poland (Nikiel and Opiela, 2002) find that foreign-owned banks

[1] The main reason for relatively scarce worldwide evidence of cross-border bank expansion can be the limited success of international takeovers. Major impediments that make banks reluctant to go abroad are related to the geographical distance, language barriers, cultural aspects of home countries and differences in regulatory and supervisory structures (Buch, 2000, Berger et al., 2001).

are more efficient than domestic banks, while other studies on Hungary (Sabi, 1996), Croatia (Kraft and Tirtiroglu, 1998) and Czech Republic (Matoušek and Taci, 2002) find no evidence supporting this view. Similarly, cross-country studies by Bonin et al. (2005), Fries and Taci (2005) and Grigorian and Manole (2006) conclude that foreign participation tends to improve the efficiency of domestic banks in CEECs, while Poghosyan and Borovička (2007) find that the positive effect of foreign ownership on cost efficiency may be biased due to the cream-skimming effect (selection bias).

Most of this literature, however, does not distinguish between different modes of foreign entry. The mode of entry can be crucial in interpreting the impact of foreign bank participation, since different entry modes are driven by different motives. Havrylchyk and Jurzyk (2008) distinguish between acquired and greenfield banks and provide further evidence on the existence of a selection bias. However, they conclude that the superior performance of CEECs banks acquired by foreigners is earned rather than inherited.[2] Claeys and Hainz (2007) distinguish between greenfield entry and foreign acquisition in CEECs banking sectors and find that bank lending rates have generally declined due to the foreign entry, but the impact is mainly driven by the greenfield establishments.[3] A similar conclusion is drawn for the case of Latin American countries by Martinez Peria and Mody (2004). They find that interest margins of foreign greenfield banks are lower than interest margins of domestic banks, as well as interest margins of foreign banks that have entered through cross-border acquisitions.

The aim of this paper is to provide further insights on the relationship between different modes of foreign entry and characteristics of banking systems in CEECs in terms of efficiency and market power. Unlike previous studies, this paper explicitly acknowledges the possible interplay between efficiency and competition when examining market power of domestic and foreign banks. Our empirical specification is derived from a simple bank intermediation model, which allows analyzing market power of banks after taking into account the cost efficiency effects. The analysis is performed in two steps. First, the stochastic frontier model (SFA) is applied to evaluate the cost efficiency of banks in CEECs. In the SFA formulation, time-varying efficiency scores enable us to evaluate the possible spillover effects from the increased foreign bank participation to the efficiency of banks in CEECs. In addition, the efficiency scores are modeled as a function of the bank ownership structure in order to distinguish between the

[2]Still another evidence of selection bias characterizing foreign bank entry is provided by Lanine and Vander Vennet (2007). The authors find that foreign banks explicitly target large banks in CEECs in order to extract benefits from increased market power. Poghosyan and De Haan (2008) show that the characteristics of target banks in terms of their size and performance depend on the macroeconomic environment and institutional background of host countries.

[3]It is important to note that the authors acknowledge that greenfield banks can exhibit additional market power by specializing in particular segments of the market, but they do not provide empirical tests for this hypothesis.

relative performance of domestic, foreign greenfield, and foreign acquired banks. Second, we evaluate the relative market power possessed by banks having different ownership structures using an equilibrium relationship between bank lending rates, deposit rates, and marginal costs (free of inefficiency effects) obtained from the intermediation model.

We find that greenfield banks are characterized by a higher degree of cost efficiency relative to the domestic banks and foreign banks that entered through cross-border acquisitions. Performance of the acquired banks deteriorates in the initial year of entry and improves the year thereafter, resulting in an insignificant overall effect. The hypothesis that banking systems in CEECs are characterized by a competitive market structure is rejected. However, the market power of foreign acquired banks is substantially lower compared to the rest of the banks, confirming the positive impact of foreign bank entry on competition. Our results remain unchanged when riskiness of bank portfolio, income from non-interest banking activities and developments in the macroeconomic environment are taken into account.

The remainder of the paper is structured as follows. The next section presents a simple bank intermediation model and outlines empirical strategy for testing the proposed hypotheses. Section 3 describes data used in our analysis. Estimation results and their discussion are provided in Section 4. The last section concludes.

# 2 Methodology

## 2.1 Theoretical background

The general framework for our investigation is the "new empirical industrial organization" approach of Bresnahan (1982), which has been adopted for the case of banking by Shaffer (1989, 1993) and extended to the "intermediation model" in more recent studies by Barajas et al. (1999) and Vera et al. (2007).

Consider a representative bank $i$ producing output in the form of loans or earning assets ($L_i$), and using deposits or financial liabilities ($D_i$) and non-financial factors (labor and capital) as inputs. Apart from loans, the bank is also required to hold reserves with the monetary authority ($R_i$) on the asset side. The difference between total assets and deposits constitutes a residual term called other net liabilities ($ONL_i$).[4] The balance sheet condition for each bank is: $L_i + R_i = D_i + ONL_i$. Given the reserve requirement ratio ($\rho_i = \frac{R_i}{D_i}$), the balance sheet condition can be rewritten as:

$$L_i - D_i(1 - \rho_i) - ONL_i = 0. \tag{1}$$

[4]This term can be further decomposed into bank equity and the rest of other net liabilities. We make use of the fact that the minimal amount of equity hold by the bank given its earning assets is restricted exogenously by the regulatory authorities and focus on competition in deposits and loans markets.

In this simple formulation, there is no uncertainty and banks strive for profit maximization. Each bank earns income from provision of loans ($r_L L_i$) and pays interest on acquired deposits ($r_D D_i$). In addition, each bank incurs non-financial (real) costs from engaging into financial intermediation ($C_i$), that depend on the output level ($L_i$), prices for labor and capital ($w$), and other non-financial inputs ($x$). Consequently, each bank's profits ($\pi_i$) can be expressed as the difference between financial revenues and total (financial and non-financial) costs:

$$\pi_i = r_L L_i - r_D D_i - C_i(L_i, w, x), \tag{2}$$

where $r_L$ and $r_D$ are the average lending and deposit rates. Banks maximize their profits by choosing the optimal level of output. The first order condition for profit maximization is:[5]

$$\frac{\partial \pi_i}{\partial L_i} = r_L + L_i \frac{\partial r_L}{\partial L_i} - r_D \frac{\partial D_i}{\partial L_i} - D_i \frac{\partial r_D}{\partial L_i} - C_{L_i} = 0, \tag{3}$$

where $C_{L_i} = \frac{\partial C_i(L_i, w, x)}{\partial L_i}$ is the marginal non-financial cost of loan production. Making use of the relationship between deposits and loans ($\frac{\partial D_i}{\partial L_i} = \frac{1}{1-\rho_i}$) from the balance sheet identity (1) and rearranging terms in the first order condition yields the following equation for the interest rate spread:

$$r_L - \frac{r_D}{1-\rho_i} = -L_i \frac{\partial r_L}{\partial L_i} + D_i \frac{\partial r_D}{\partial D_i} \frac{1}{1-\rho_i} + C_{L_i}. \tag{4}$$

This equation provides several useful insights. First, the interest rate spread is affected by the reserve requirements imposed by monetary authorities, which represent financial taxation costs incurred by a bank. Second, the size of the spread is affected by the production technology used by a bank. More cost efficient banks use fewer resources to produce the required optimal level of output, which results in a smaller difference between lending and deposit rates. Third, the wedge between the lending and deposit rates is driven by the market power of a bank. In the case of a non-perfect competition, an individual bank will be able to influence the industry-wide interest rates, as indicated by the terms $\frac{\partial r_L}{\partial L_i}$ and $\frac{\partial r_D}{\partial D_i}$.

Shaffer (1989, 1993) assumes that deposit markets are perfectly competitive ($\frac{\partial r_D}{\partial D_i} = 0$) and estimates equation (4) jointly with the demand function for industry-wide loans. In his formulation, the interest rate elasticity of demand for loans in equation (4) is substituted from the aggregate demand function and marginal cost is assumed to be a linear function of input prices and output quantity. The system estimation approach yields a market power parameter estimate for the loans market in the form of a conjectural variation coefficient, as is customary in the "new empirical industrial organization" literature.

[5]Here we follow a quantity competition approach, in line with the "new empirical industrial organization" literature. However, it is important to note that a more realistic price competition approach would result in a similar equilibrium condition linking marginal revenues and marginal costs of banks, which is used to test our main hypotheses (see Freixas and Rochet, 2008, Chapter 3 for technical details).

We pursue a slightly more restrictive approach suggested by Barajas et al. (1999), which does not require a system estimation.[6] Using the definitions of the interest rate elasticity of demand for loans ($\eta_L = \frac{\partial L}{\partial r_L}\frac{r_L}{L} < 0$) and the interest rate elasticity of demand for deposits ($\eta_D = \frac{\partial D}{\partial r_D}\frac{r_D}{D} > 0$), equation (4) can be rewritten as:

$$r_L + r_L\left[\frac{L_i}{L}\frac{dL}{dL_i}\frac{1}{\eta_L}\right] = \frac{r_D}{1-\rho_i} + \frac{r_D}{1-\rho_i}\left[\frac{D_i}{D}\frac{dD}{dD_i}\frac{1}{\eta_D}\right] + C_{L_i}. \tag{5}$$

Let's further denote $SL_i = \frac{L_i}{L}$ and $SD_i = \frac{D_i}{D}$ as shares of bank $i$ in the loan and deposit markets, respectively. In addition, let's denote $RL_i = \frac{dL}{dL_i}$ ($RD_i = \frac{dD}{dD_i}$) as the responsiveness of the total industry supply of loans (deposits) to the adjustment of loans (deposits) by bank $i$. Using this notation, equation (5) can be rewritten as:

$$r_L\left[1 + \frac{SL_iRL_i}{\eta_L}\right] = \frac{r_D}{1-\rho_i}\left[1 + \frac{SD_iRD_i}{\eta_D}\right] + C_{L_i}. \tag{6}$$

Equation (6) explicitly reflects the different effects influencing the market power of banks, which are summarized by the expressions in brackets. An individual bank possesses higher market power if the industry supply is less elastic; the size of bank operations is larger, and the response of the industry output to the individual bank output decisions is greater. Rearranging the equation and expressing the measure of market power in the loan market as $MP_{L_i} = \left[1 + \frac{SL_iRL_i}{\eta_L}\right]$ and the measure of market power in the deposits market as $MP_{D_i} = \left[1 + \frac{SD_iRD_i}{\eta_D}\right]$ yields:[7]

$$r_L = \frac{r_D}{1-\rho_i}\left[\frac{MP_{D_i}}{MP_{L_i}}\right] + \frac{C_{L_i}}{MP_{L_i}}. \tag{7}$$

Given the sign restrictions on the interest rate elasticities of loan demand ($\eta_L \leq 0$) and deposit supply ($\eta_D \geq 0$), the possible values for market power indicators can be derived as $MP_{L_i} \leq 1$ and $MP_{D_i} \geq 1$, respectively.

In the case of a perfectly competitive industry, both indicators take the value of unity and, hence, the coefficient $\frac{MP_{D_i}}{MP_{L_i}}$ is equal to unity as well. In this case, the marginal revenue (interest rate on loans) will be equal to the financial and non-financial marginal costs (deposit rate and derivative of the cost function).

In the presence of market power in at least one of the markets ($MP_{L_i} < 1$ and/or $MP_{D_i} > 1$), the coefficient $\frac{MP_{D_i}}{MP_{L_i}}$ will be greater than unity. Barajas et al. (1999) and Vera et al. (2007) use equation (7) as an alternative framework for testing the null hypothesis of no market power

[6]Econometric estimations of a system of equations using a full information maximum likelihood method is problematic, since it produces inconsistent estimates for the whole system if one or more of the equations are misspecified. Three-stage least squares method is an alternative estimator widely used in the literature, but it assumes the availability of appropriate instruments.

[7]In the "new empirical industrial organization" literature, the terms $MP_{L_i}$ and $MP_{D_i}$ have been given an interpretation of conjectural variations. However, we would refrain from this interpretation and would rather view these terms as measures of gap between the price of bank output and the marginal cost.

($\frac{MP_{D_i}}{MP_{L_i}} = 1$), which is more simplistic relative to the system approach used in Shaffer (1989, 1993). For this purpose, these studies assume that the marginal cost ($C_{L_i}$) in equation (7) is a linear function of bank output ($L_i$) and input prices ($w$). This assumption, however, is not innocuous. It disregards the cost efficiency of banks, which was found to be an important determinant of net interest margins in several recent studies (see, for instance, Maudos and Fernandez de Guevara, 2004). More efficient banks have the opportunity to operate with a lower margin due to the gains from the less expensive conduct of intermediation activities. Therefore, the analysis in this paper improves upon previous work by explicitly taking cost efficiency of banks into account when evaluating their marginal costs. The next subsection provides the details of our empirical approach.

## 2.2 Empirical methodology

The empirical assessment of the market power possessed by domestic and foreign banks in at least one of the markets (loan or deposit) is based on the econometric estimation of the equation (7), which can be represented in terms of a linear regression:

$$r_{L_{it}} = \beta_0 + \beta_1 \tilde{r}^d_{D_{it}} + \beta_2(\tilde{r}^d_{D_{it}} * D^{GF}) + \beta_3(\tilde{r}^d_{D_{it}} * D^A) + \beta_4 C_{L_{it}}, \tag{8}$$

where indices $i$ and $t$ denote bank and time, respectively, $r_{L_{it}}$ is the implicit loan rate, $\tilde{r}^d_{D_{it}} = \frac{r^d_{D_{it}}}{1-\rho_i}$ is the implicit deposit rate adjusted for the impact of financial taxation,[8] $D^{GF}$ and $D^A$ are dummy variables for foreign greenfield and acquired banks, and $C_{L_{it}}$ is the marginal cost of producing an extra unit of output for bank $i$ in time $t$. Abstracting from interaction terms, a value of coefficient $\beta_1$ significantly larger than one would indicate the presence of market power in at least one of the markets (loans or deposits) for the whole banking industry, including both domestic and foreign banks. Introduction of the interaction terms allows to identify whether the extent of market power differs between domestic and foreign banks. For instance, a significantly negative (positive) coefficient $\beta_2$ would suggest that market power of foreign greenfield banks is lower (higher) than market power of domestic banks. The magnitude and sign of the coefficient $\beta_3$ can be interpreted in a similar way.

To carry out an econometric estimation of equation (8), one needs to introduce a measure of marginal costs into the specification. Instead of pursuing the strategy of Barajas et al. (1999) and Vera et al. (2007) and proxying the linear relationship between marginal costs and their

[8]The level of financial taxation $\rho_i$ is an approximate measure, which serves only as a guideline for banks in their intermediation activities. In reality, banks often hold excess reserves in their accounts at the central bank for liquidity reasons. In addition, banks borrow money from the central bank in case their reserves are not sufficient to fulfill the reserve requirements set up by the regulators. In the empirical estimations, we use country-specific reserve requirements information from the international survey on banking regulation available in Barth et al. (2008).

underlying factors in an *ad hoc* fashion, the marginal costs are obtained directly from the data using the stochastic efficiency frontier methodology.[9] The advantage of this approach is that it explicitly takes the impact of the cost efficiency of banks on the marginal cost of producing an additional unit of output into account. By including the "inefficiency-free" measure of marginal costs, we also control for the possible relationship between market power of banks and their efficiency. In addition, using the information on the timing of cross-border bank acquisitions, we are able to evaluate whether domestic banks taken over by foreigners improve their operational efficiency after the acquisition.

Consistent with the intermediation model described above, let's assume that banks produce one unit of output ($L$) using labor, capital and borrowed funds as inputs. Let $w_1$, $w_2$ and $w_3$ denote the prices of labor, capital and borrowed funds. To capture the technological progress experienced by banks in CEECs during the last decade,[10] a time trend ($Trend$) is introduced among the determinants of the cost frontier. In line with previous cross-country studies, we also control for possible shifts in the cost frontiers across countries due to differences in macroeconomic environment and institutional background by introducing country-specific ($C_n$) and time-specific ($T_m$) dummy variables. The final translog specification of the cost function for the stochastic frontier analysis takes the following form:[11]

$$\begin{aligned}
\ln\frac{C_{it}}{w_{it,1}} &= \alpha_{i0} + \alpha_1 \ln L_{it} + \alpha_2 \ln\left(\frac{w_{it,2}}{w_{it,1}}\right) + \alpha_3 \ln\left(\frac{w_{it,3}}{w_{it,1}}\right) + \alpha_4 Trend + \\
&+ \delta_{11}\frac{1}{2}\left(\ln L_{it}\right)^2 + \delta_{12}\ln L_{it}\ln\left(\frac{w_{it,2}}{w_{it,1}}\right) + \delta_{13}\ln L_{it}\ln\left(\frac{w_{it,3}}{w_{it,1}}\right) + \delta_{14}\ln L_{it} Trend + \\
&+ \gamma_{11}\frac{1}{2}\left(\ln\left(\frac{w_{it,2}}{w_{it,1}}\right)\right)^2 + \gamma_{12}\ln\left(\frac{w_{it,2}}{w_{it,1}}\right)\ln\left(\frac{w_{it,3}}{w_{it,1}}\right) + \gamma_{13}\ln\left(\frac{w_{it,2}}{w_{it,1}}\right) Trend + \\
&+ \theta_{11}\frac{1}{2}\left(\ln\left(\frac{w_{it,3}}{w_{it,1}}\right)\right)^2 + \theta_{12}\ln\left(\frac{w_{it,3}}{w_{it,1}}\right) Trend + \rho_{11}\frac{1}{2}(Trend)^2 + \\
&+ \sum_{n=1}^{11}\phi_n C_n + \sum_{m=1}^{16}\phi_m T_m + u_{it} + v_{it}, \qquad (9)
\end{aligned}$$

where $\alpha_{i0}$ captures individual bank random effects, $v_{it} \sim N(0, \sigma_v^2)$ is the i.i.d. error term and $u_{it} = B_t u_i$ is the positive inefficiency term varying across banks and over time, which is composed of two parts: a non-stochastic positive time component, $B_t > 0$, that is time-varying but the same for all banks and a stochastic individual component, $u_i \sim N^+(\mu, \sigma_u^2)$, which follows

[9] Kumbhakar and Lovell (2000) contains an excellent textbook exposition of the stochastic efficiency frontier methodology. Poghosyan and Borovička (2007) is a recent application of this methodology for measuring the cost efficiency of banks in a set of transition economies (including CEECs).

[10] See Fries and Taci (2005), Bonin et al. (2005) and Poghosyan and Borovička (2007) for the recent empirical evidence.

[11] This formulation takes into account the adding-up and symmetry restrictions imposed by theory. In addition, the linear homogeneity restriction is satisfied by deflating costs and the second input price by the first input price.

a truncated normal distribution with a conditional mean parameter $\mu$. The inefficiency term can be expressed in a general form as:

$$u_{it} = exp(\eta' Z_{it}) u_i, \tag{10}$$

where $Z_{it}$ is a vector of factors affecting bank efficiency and $\eta$ is a vector of coefficients. We use several determinants of bank efficiency. First, the efficiency is modeled as a function of time using the specification of Kumbhakar and Wang (2005): $(t - \underline{t})$, where $\underline{t}$ is the beginning of the sample. A significant positive (negative) coefficient in front of this variable would indicate that over the whole sample period, efficiency of the banking sectors in CEECs has deteriorated (improved). Since the sample period was marked by increased foreign bank participation, the coefficient of this variable can be interpreted in terms of the overall impact of foreign bank participation on bank efficiency in CEECs. Next, in order to discern the differences in cost efficiency across domestic and foreign banks, we introduce dummy variables for foreign greenfield ($D^{GF}$) and foreign acquired banks ($D^{A}$) into the inefficiency specification (10). A significant positive (negative) coefficient of these dummy variables would indicate that the post-entry efficiency of the corresponding foreign-owned banks is on average lower (higher), in comparison to the rest of the banking system. Finally, in a separate set of estimations, we introduce current and lagged dummy variables for the year when the domestic bank was taken over in order to evaluate the dynamic effect of cross-border bank acquisitions on the banks' performance.

Using results from the stochastic frontier model, the estimate of the marginal cost term for bank $i$ at time $t$ ($\hat{C}_{L_{it}}$) is obtained through the partial derivative of the translog function:

$$\hat{C}_{L_{it}} = \frac{C_{it}}{L_{it}} \frac{\partial \ln C_{it}}{\partial \ln L_{it}} = \frac{C_{it}}{L_{it}} \left[ \hat{\alpha}_1 + \hat{\delta}_{11} \ln L_{it} + \hat{\delta}_{12} \ln \left( \frac{w_{it,2}}{w_{it,1}} \right) + \hat{\delta}_{13} \ln \left( \frac{w_{it,3}}{w_{it,1}} \right) + \hat{\delta}_{14} Trend \right]. \tag{11}$$

The marginal cost term $\hat{C}_{L_{it}}$ is adjusted for the influence of bank inefficiency and can enter as an explanatory variable in equation (8). Using the generated regressor $\hat{C}_{L_{it}}$ on the right hand side of (8) will influence the efficiency of the coefficient estimates due to the biased standard errors (see Pagan, 1984). Therefore, the standard errors of the coefficient estimates are bootstrapped using 2000 replications to ensure the robustness of our results.[12]

# 3 Data Description

The main source for the bank-specific information is the BankScope database of Bureau Van Dijk, from which the information on individual banks operating in 11 CEECs (Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and

[12]The number of bootstrap replications is chosen based on the optimal criteria suggested by Andrews and Buchinsky (2000).

Slovenia) is retrieved for the 1992-2006 period. The dataset contains information on balance sheets and income statements of 364 commercial, cooperative and savings banks.[13] Unfortunately, BankScope does not provide historical information on bank ownership, which is crucial for our analysis. Therefore, we utilize the information on foreign-owned banks for the years 1992-2004 from the extended dataset of De Haas and Van Lelyveld (2006) employed in Havrylchyk and Jurzyk (2008).[14] This dataset categorizes foreign-owned banks into two groups: greenfield establishments and banks taken over as a result of a cross-border acquisition. For the remaining two years, we update the missing foreign ownership information using a list of cross-border bank acquisitions from Securities Data Company (SDC) mergers and acquisitions database produced by Thompson Financial. From this source, data on completed (effective) cross-border acquisitions are extracted (i.e. parents of bidder and target banks have different countries of origin), which involve target banks from CEECs and that result in the control of ownership by the bidder bank exceeding 50% of the equity.

Table 1 displays the evolution of foreign bank entry into CEECs. The dominant mode of foreign entry in the initial stage of transition has been the establishment of greenfield subsidiaries. The number of greenfield banks has grown rapidly by mid 1990's, remaining at comparable level afterwards. Cross-border acquisitions became a popular mode of entry after the mid 1990's, growing at an accelerating pace with EU enlargement. In the last year of the sample, the share of total banking system assets controlled by foreign banks amounted to 65.3%,[15] out of which 15.1% (50.2%) is controlled by greenfield (acquired) banks, respectively.

Table 2 lists and describes the variables used and their sources. All variables are measured in US dollars and deflated by the consumer price index, using 1995 as a reference year.[16] Before proceeding with the empirical analysis, observations with missing information in at least one of the variables listed in Table 2 are dropped. Furthermore, to confront the influence of extreme observations and reporting errors, all variables are winsorized at the $1^{st}$ and $99^{th}$ percentiles.

Descriptive statistics of the resulting dataset are reported in Table 3. The Table shows that foreign greenfield banks have lower scale of operations and incur lower costs in comparison to the foreign acquired and domestic banks. This is due to the fact that the main mission of greenfield banks is to serve their clients abroad, rather than to engage into full scale operational activities in CEECs. There is also high variation in terms of loan rates: domestic and foreign greenfield

[13]We use unconsolidated statements of banks, replacing them by consolidated statements whenever information on unconsolidated statements is not available.

[14]We thank Emilia Jyrzyk and Iman Van Lelyveld for kindly sharing their data on bank ownership.

[15]Difference between the share of total assets controlled by foreign-owned banks in the sample and the EBRD information reported in Figure 1 is due to the fact that BankScope does not cover all banks in the economy. In addition, our estimates refer to commercial, cooperative and savings banks only, while the EBRD data covers all banks in the country.

[16]Consumer price index data are extracted from the World Bank's World Development Indicators database.

banks charge on average more for their loans that foreign acquired banks. However, the variation of deposit rates across banks is relatively modest. This observation can be explained by the fact that depositors find it easier to switch banks when discrepancy in deposit rates is high, while lending rates are to a large extent influenced by relationships of banks with their clients (Petersen and Rajan, 1994). Domestic and foreign banks also differ in terms of the riskiness of their loan portfolios: domestic and foreign acquired banks have higher loan-loss provision reserves relative to the foreign greenfield banks.

To sum up, the preliminary analysis of the descriptive statistics highlights apparent differences between domestic, foreign greenfield, and foreign acquired banks in terms of the scale of their operations, incurred costs, and riskiness. These differences may be related to different missions and strategies employed by these banks, reflected in their portfolio mix. However, the simple comparison made using summary statistics lacks theoretical argumentation and does not allow drawing firm conclusions regarding foreign bank entry effects on efficiency and market power. In the remainder of the paper, these issues are addressed using a more formal framework.

# 4 Estimation Results

## 4.1 Foreign bank entry and cost efficiency

The empirical approach for evaluating the impact of foreign entry on bank efficiency is based on the stochastic efficiency frontier methodology (SFA). We follow the intermediation approach widely used in the banking literature (Sealey and Lindley, 1977) and assume that banks are minimizing their costs given the optimal amount of earning assets to be generated, prices for inputs (labor, capital and financial resources) and technological constraints. Bank costs ($C$) are measured as the total operating expenses incurred by banks. Bank output ($L$) is proxied by the total earning assets in the bank's portfolio.[17] Following the literature on bank efficiency, labor prices are measured as the ratio of personnel expenses to total assets ($w_1$), capital prices as the ratio of administrative expenses (other than personnel expenses) to total assets ($w_2$) and prices of borrowed funds as the ratio of interest expenses to a sum of total deposits and other funding ($w_3$). We control for the possible influence of environmental differences across countries (e.g., macroeconomic developments, institutional background) and over time (e.g., shocks common to all CEECs), by using country and time dummies.

The outcomes of the SFA model estimations are summarized in Table 4. The main focus of this analysis is the determinants of cost inefficiency, shown in the middle panel of the Table. Let's start by introducing time trend as inefficiency determinant in the specification (I). The

[17] In a separate set of estimations, we subdivided bank output into two categories: total loans and total security holdings. The estimation results yielded qualitatively similar outcomes and are available upon request.

negative significant coefficient of the trend variable suggests that efficiency of banks in CEECs has on average improved over time, which is in line with the evidence provided by Rossi et al. (2004). Increased foreign bank participation has possibly influenced this general efficiency improvement directly (through the higher efficiency of foreign banks) or indirectly (through the increased competition due to foreign entry and knowledge spillovers).[18]

In order to evaluate the direct impact of foreign bank participation, in specifications (II) and (III) dummy variables for foreign greenfield and foreign acquired banks are introduced. The estimation results suggest that foreign greenfield banks have higher efficiency than the rest of the banking sector, while the impact is insignificant for the foreign acquired banks. Introducing both dummy variables simultaneously as inefficiency determinants in the specification (IV) does not alter these results. This finding has important policy implications: it highlights the importance of the entry mode on the performance of foreign banks. It also suggests that the primary motivation behind foreign entry affects the post-entry performance of banks. While foreign greenfield banks are mainly established with the purpose to serve the clients of their parent banks, the entry via cross-border acquisitions is primarily motivated by the efficiency improvements and market power considerations (Lanine and Vander Vennet, 2007). As argued by Detragiache et al. (2008), bank costs after the takeover can increase due to additional expenses related to the need to increase the quality of monitoring activities.[19] In order to capture this dynamic effect, in specifications (V) - (VII) current and lagged dummy variables for the year when the bank was taken over are introduced.[20] We find two offsetting effects on the efficiency following the foreign acquisition: the immediate impact is significantly positive (deterioration of bank efficiency), while the one period lagged impact is significantly negative (improvement of bank efficiency). These two offsetting effects together with the fact that efficiency gains disappear in the second period, as shown in the specification (VII), might explain the insignificant overall impact of the acquisition dummy variable in the specifications (III) and (IV).

These findings are also in line with various case studies on foreign bank acquisitions in

[18]In a separate set of regressions, we replaced the time trend by the yearly series on the market share of foreign bank assets from EBRD (2007). In these estimations (available upon request), a significant negative coefficient in front of the foreign market share variable was obtained, suggesting that the efficiency improvement is correlated with the increased foreign bank participation.

[19]Another explanation for the insignificant relationship between the bank acquisition and its subsequent efficiency improvement might be the additional costs incurred in the process of reorganization and restructuring, which most of the banks undergo following the takeover. Still another possibility might be that target banks introduce new services, which requires installation of new equipment and facilities causing an upsurge of costs in the short-run.

[20]This dummy variable captures 64 cross-border bank acquisition events. The number of feasible observations for cross-border acquisitions decreases to 53 (44) when the impact of the takeover is evaluated with a one period (two periods) time lag.

CEECs. For instance, Abarbanell and Bonin (1997) discuss the impact of privatization of the Polish Bank Slaski (BSK) to a foreign investor in the 1990s. The authors find that the privatization of the bank by foreign investors did not lead to an immediate improvement of its managerial performance. One explanation is that the top management who ran the bank prior to the privatization did not change following the privatization, due to the "...strength of personality, political influence, and superior knowledge of banking..." (Abarbanell and Bonin, 1997, p. 46). Similar evidence has been documented in a case study on privatization of the Russian Zhilsotsbank (Abarbanell and Meyendorff, 1997). However, the authors caution that the results of privatization should not be judged only on the basis of the short-run financial performance and that a "...critical lesson to be learned from the privatization of BSK is the importance of a foreign financial investor taking an active role in the development of bank strategy to bring about the fundamental changes necessary to realize the potential franchise value." (Abarbanell and Bonin, 1997, p. 57).

To sum up, we find that the mode of foreign entry has different implications for bank efficiency. Foreign greenfield banks outperform domestic banks in terms of cost efficiency, while the efficiency of foreign acquired banks is not significantly different from that of domestic banks. The later result can be explained by offsetting effects on efficiency following the foreign acquisition.

## 4.2 Foreign bank entry and market power

In order to evaluate the market power of banks, the following variables are used in specification (8): the implicit lending rate ($r_{L_{it}}$) is defined as the ratio of total interest income to total loans, and the implicit deposit rate ($r_{D_{it}}$) is proxied by the ratio of total interest expenses to total deposits. The deposit rates are adjusted by the corresponding reserve requirement ratios in each of the CEECs (see Table 2). To evaluate the impact of foreign ownership on market power of banks, interaction terms of the average deposit rate with a foreign greenfield bank dummy ($r_{D_{it}} * D^{GF}$) and with a foreign greenfield bank dummy ($r_{D_{it}} * D^{A}$) are introduced. Together with the marginal cost estimates ($\hat{MC}$) obtained from the SFA specification (IV) in Table 4, these variables can be used for conducting the market power test using equation (8).

Table 5 shows the estimation results of (the augmented) equation (8). We account for heterogeneity across banks located in different CEECs with varying levels of economic development and regulatory structures by applying a panel data estimation technique. All estimations are done by fixed-effects OLS, which was found to outperform the random-effects method based on the Hausman test. Standard errors are estimated using residuals clustered by countries, to relax the assumption of cross-sectional independence. Panel test for serial correlation based on

the procedure of Drukker (2003) suggests that residuals in all specifications are free from first order autocorrelation effects.

Specification (I) describes the baseline model. The coefficient of the deposit rate variable is significant and greater than one. The Wald test rejects the hypothesis that the market power coefficient is equal to one, suggesting that the CEECs banking system as a whole exhibits market power. This finding applies to all banks in CEECs, regardless of their ownership. To evaluate the impact of bank ownership on market power, the corresponding interaction terms are included in specifications (II) and (III). The coefficients of interaction terms suggest that foreign acquired banks have a significantly lower market power compared to the rest of the banking system, while the market power of greenfield foreign banks is not significantly different from the rest of the banking system. This finding does not alter when both interaction terms are added to the model simultaneously in the specification (IV). The Wald test suggests that market power coefficient of foreign acquired banks is not significantly different from one, supporting the competitive markets hypothesis for these banks. This result contrasts the prediction of the Claeys and Hainz (2007) model, in which competition in the domestic banking markets is stronger for the greenfield entry, compared to the acquisition entry.[21] Our estimations suggest that cross-border bank acquisitions result in a more competitive banking environment, which has important policy implications.

### 4.2.1 Robustness check

There are several important aspects of banking that are not captured in the theoretical model of market power. The first is the presence of uncertainty and credit risk. To control for the impact of risk, we follow Barajas et al. (1999) and Vera et al. (2007) and introduce the share of loan-loss provisions in total loans as a proxy of quality of bank loan portfolio.[22] The second aspect is the presence of non-interest banking services, which might be considered as additional revenue for banks and might influence their degree of riskiness and market power (Lepetit et al., 2008). To control for the impact of fee-generating activities of banks, we follow Maudos and Fernandez de Guevara (2004) and augment our specification by introducing the ratio of non-interest revenues to total assets as a proxy for implicit interest revenues of banks. Finally, macroeconomic fundamentals might influence the depth of financial intermediation in the country (Cotarelli et al., 2005) and decision of banks to go abroad. We control for the macroeconomic environment by introducing real GDP growth, inflation and exchange rate changes in our specification.

[21] Claeys and Hainz (2007) do not consider the "follow clients abroad" motive for foreign bank entry in their model, which might explain this contradictory result.

[22] A more direct measure of loan portfolio quality would be the share of non-performing loans in total loans. However, BankScope is missing information on non-performing loans for more than half of banks in the sample, for which reason we rely on loan-loss provisions as an indicator of loan portfolio quality.

The introduction of additional variables to control for banking risks ($LLP$), service incomes ($IMPL$) and macroeconomic environment ($GDP$, $INFL$ and $FX$) in specifications (V), (VI), and (VII) does not change the main results. In particular, the coefficient of the interaction term with foreign greenfield dummy remains insignificant, implying that even after accounting for credit risks, non-interest banking activities and macroeconomic variables, greenfield banks do not exhibit greater market power than the rest of the banks. This can be due to the special position that greenfield banks occupy for their customers in CEECs, since most of them do not have alternative sources of bank financing due to already established relationships with their long-term partner banks.

In line with the theoretical prediction, banks with riskier loan portfolios and higher share of non-interest banking activities charge higher lending rates.[23] The later result supports the findings of Lepetit et al. (2008), according to which banks expanding to non-interest income activities are riskier than banks focused on lending, which is reflected in higher loan rates. Among macroeconomic variables, we find positive and significant effect of exchange rate depreciation on loan rates, which suggests that currency stability has important implications for lending decisions of banks.

To sum up, the estimation results reject the competitive market structure hypothesis in CEECs, as the estimated market power coefficients are significantly larger than one for the whole banking sector. This indicates that banks in CEECs possess market power at least in one of the markets (loans or deposits).[24] The market power of foreign acquired banks is significantly lower than that of the rest of the banks. Foreign greenfield banks don't exhibit lower market power, suggesting that increase in competition as a result of the foreign entry is mainly driven by cross-border acquisitions.

# 5 Conclusion

The recent sharp increase in foreign bank participation in CEECs raises a series of questions regarding the implications of this pattern for banks and customers in host countries. This study highlights the existence of a complex relationship between different modes of foreign bank entry and the post-entry banking performance.

[23]Since interest income of banks can be affected by the quality of loan portfolio, using LLP among explanatory variables may introduce endogeneity bias in coefficient estimates. To control for possible endogeneity, in a separate set of regressions we use lagged LLP among explanatory variables. The estimation results are qualitatively similar to the specification with contemporaneous LLP and are available upon request.

[24]Since the deposit market is likely to be more competitive than the loan market due to the negligible bank switching costs for depositors and prevalence of relationship-based lending, we suggest that the main part of the market power comes from the loan markets. Relatively lower variation of deposit rates relative to the loan rates in our sample lends support for this argumentation (see also discussion in Section 3).

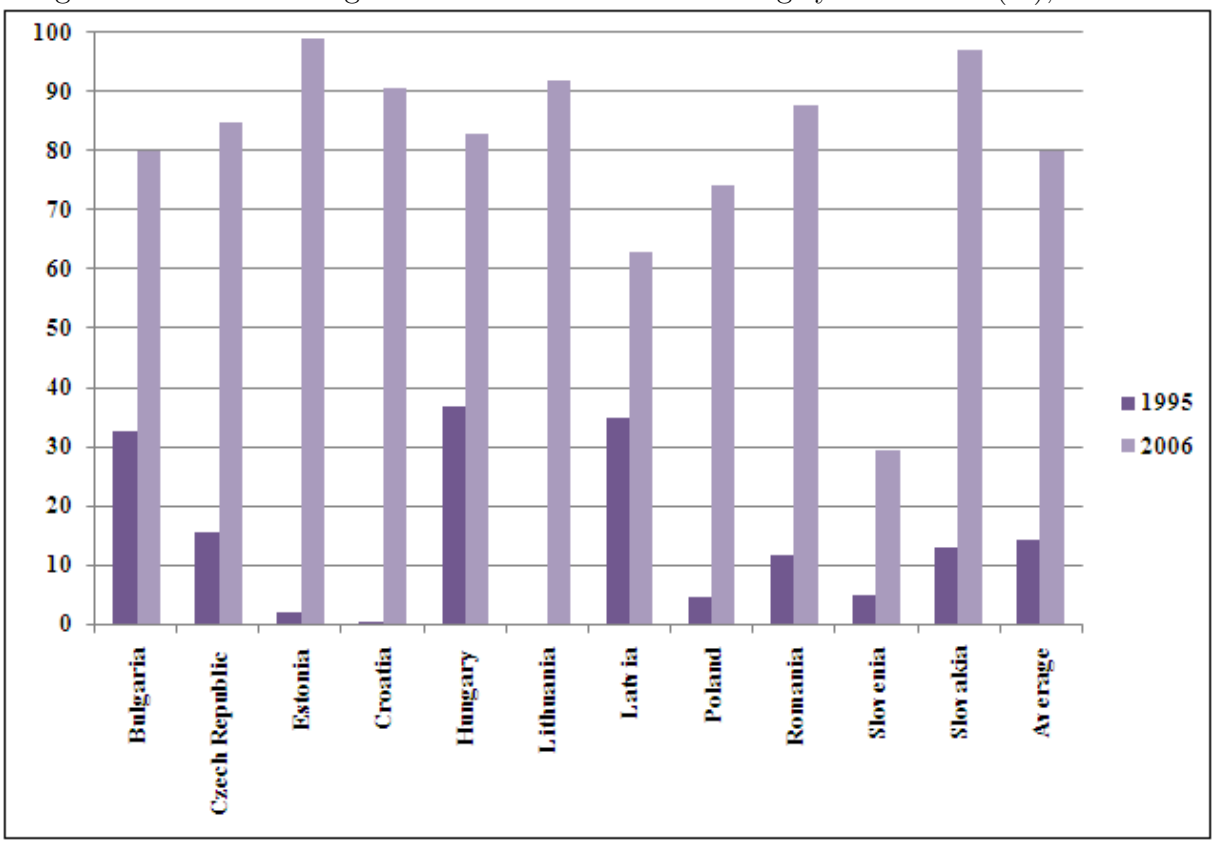
Foreign greenfield banks exhibit superior operational efficiency in comparison to domestic and foreign acquired banks. This can be explained by the specialization of greenfield banks to serve customers of their parent banks abroad and already established banking relationships. The performance of foreign acquired banks exhibits an offsetting dynamic pattern: the efficiency deteriorates in the initial year of acquisition, slightly improving in the subsequent year. The overall impact on the post-acquisition performance evaluated for the whole sample is insignificant, which can be due to the poor managerial and financial characteristics of target banks in CEECs inherited by foreign investors.

We also find evidence on differences in market power across domestic and foreign banks. Market power of foreign greenfield banks is not significantly lower than that of domestic banks. This result holds when the impact of credit risks, non-interest banking activities and macroeconomic environment are taken into account, contrasting the evidence from studies, which do not control for the cost efficiency of banks when analyzing market power. Unlike greenfield entrants, foreign acquired banks exhibit a substantially lower degree of market power, which can be explained by the increased competition due to foreign entry and the strategic considerations of foreign banks entering a new market.

The analysis conducted in this study provides important policy implications. It documents a significant improvement of banking performance in CEECs measured by cost efficiency during the sample period corresponding to an increase in foreign bank participation. CEECs banks and customers clearly benefited from foreign participation directly (superior post-entry performance of greenfield banks) and indirectly (overall increase in bank efficiency due to spillover effects to domestic banks). Opening the borders for foreign entry has also contributed to the competitiveness of the banking industry in CEECs, but largely due to cross-border acquisitions. In this sense, this study finds support for the conventional believe by the policymakers that liberalization of domestic banking industry and promotion of foreign entry would have a positive impact.

However, these conclusions should be interpreted with caution, since this study does not address the issue of financial stability in CEECs. During the recent financial crisis, banking sectors in CEECs have proven to be very vulnerable to systemic external shocks. The impact of the increased foreign bank participation on financial stability is an important topic, which requires the attention of policymakers and needs to be addressed in the future research.

Figure 1: Share of foreign-owned banks in total banking system assets (%), 1995-2006




Source: EBRD (2007).

Table 1: Number of observations for domestic and foreign (acquired and greenfield) banks

| **Countries** | **Ownership** | **1992** | **1993** | **1994** | **1995** | **1996** | **1997** | **1998** | **1999** | **2000** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bulgaria | Domestic | 4 | 9 | 12 | 15 | 17 | 21 | 23 | 17 | 14 | 14 | 12 | 11 | 11 | 10 | 9 | 199 |
| | Foreign greenfield | 0 | 0 | 0 | 1 | 2 | 2 | 2 | 3 | 4 | 6 | 7 | 7 | 7 | 7 | 7 | 55 |
| | Foreign acquired | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 7 | 7 | 9 | 10 | 9 | 10 | 11 | 68 |
| Croatia | Domestic | 12 | 22 | 28 | 31 | 37 | 45 | 38 | 33 | 27 | 26 | 26 | 30 | 19 | 18 | 17 | 409 |
| | Foreign greenfield | 0 | 0 | 1 | 1 | 1 | 4 | 4 | 6 | 6 | 6 | 5 | 4 | 2 | 2 | 2 | 44 |
| | Foreign acquired | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 4 | 5 | 4 | 4 | 4 | 5 | 6 | 34 |
| Czech Republic | Domestic | 10 | 14 | 19 | 20 | 22 | 21 | 19 | 16 | 9 | 8 | 7 | 6 | 6 | 6 | 5 | 188 |
| | Foreign greenfield | 3 | 7 | 8 | 10 | 12 | 12 | 10 | 10 | 11 | 10 | 10 | 9 | 9 | 9 | 9 | 139 |
| | Foreign acquired | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 4 | 6 | 7 | 7 | 8 | 7 | 7 | 8 | 58 |
| Estonia | Domestic | 3 | 8 | 11 | 16 | 19 | 20 | 8 | 7 | 2 | 2 | 4 | 4 | 3 | 2 | 2 | 111 |
| | Foreign greenfield | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Foreign acquired | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 26 |
| Hungary | Domestic | 18 | 23 | 30 | 34 | 30 | 23 | 19 | 18 | 10 | 10 | 11 | 10 | 8 | 8 | 8 | 260 |
| | Foreign greenfield | 4 | 7 | 9 | 11 | 12 | 12 | 11 | 15 | 16 | 13 | 13 | 13 | 12 | 12 | 12 | 172 |
| | Foreign acquired | 0 | 0 | 0 | 0 | 2 | 6 | 8 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 78 |
| Latvia | Domestic | 3 | 9 | 16 | 20 | 21 | 25 | 25 | 23 | 16 | 14 | 14 | 15 | 14 | 14 | 13 | 242 |
| | Foreign greenfield | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 29 |
| | Foreign acquired | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 2 | 4 | 4 | 4 | 5 | 5 | 6 | 35 |
| Lithuania | Domestic | 1 | 5 | 9 | 11 | 14 | 17 | 16 | 15 | 8 | 6 | 5 | 5 | 5 | 4 | 4 | 125 |
| | Foreign greenfield | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Foreign acquired | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 4 | 4 | 4 | 5 | 5 | 27 |
| Poland | Domestic | 17 | 24 | 35 | 37 | 41 | 40 | 32 | 28 | 18 | 14 | 12 | 14 | 14 | 13 | 13 | 352 |
| | Foreign greenfield | 2 | 4 | 5 | 7 | 11 | 11 | 13 | 11 | 11 | 11 | 13 | 13 | 12 | 12 | 12 | 148 |
| | Foreign acquired | 0 | 0 | 0 | 0 | 1 | 3 | 4 | 10 | 14 | 16 | 16 | 15 | 15 | 16 | 16 | 126 |
| Romania | Domestic | 4 | 5 | 9 | 12 | 11 | 13 | 24 | 23 | 16 | 14 | 14 | 11 | 10 | 10 | 8 | 184 |
| | Foreign greenfield | 0 | 0 | 0 | 0 | 1 | 3 | 8 | 9 | 9 | 9 | 10 | 10 | 10 | 10 | 10 | 89 |
| | Foreign acquired | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 3 | 5 | 6 | 9 | 9 | 9 | 11 | 54 |
| Slovakia | Domestic | 4 | 6 | 9 | 11 | 13 | 16 | 16 | 15 | 10 | 7 | 5 | 4 | 3 | 3 | 3 | 125 |
| | Foreign greenfield | 1 | 1 | 2 | 4 | 7 | 9 | 10 | 8 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 103 |
| | Foreign acquired | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 5 | 7 | 7 | 6 | 6 | 6 | 39 |
| Slovenia | Domestic | 7 | 10 | 13 | 20 | 28 | 27 | 23 | 24 | 17 | 14 | 10 | 12 | 10 | 10 | 9 | 234 |
| | Foreign greenfield | 1 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 32 |
| | Foreign acquired | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 2 | 4 | 4 | 4 | 4 | 5 | 27 |
| **Total** | **Domestic** | **83** | **135** | **191** | **227** | **253** | **268** | **243** | **219** | **147** | **129** | **120** | **122** | **103** | **98** | **91** | **2,429** |
| | **Foreign greenfield** | **11** | **21** | **28** | **38** | **50** | **58** | **62** | **66** | **71** | **69** | **72** | **70** | **65** | **65** | **65** | **811** |
| | **Foreign acquired** | **0** | **0** | **0** | **0** | **3** | **12** | **22** | **34** | **52** | **65** | **72** | **76** | **73** | **78** | **85** | **572** |

Source: BankScope, Thompson Financial SDC Platinum Database, De Haas and Van Lelyveld (2006) and Havrylchyk and Jurzyk (2008).

Table 2: Variable definition and sources

| Variable | Definition | Measure | Source |
|---|---|---|---|
| $C$ | Bank costs | Total operating expenses | BankScope |
| $L$ | Earning assets | Total earning assets | BankScope |
| $w_1$ | Price of labor | Ratio of personnel expenses to total assets | BankScope |
| $w_2$ | Price of capital | Ratio of administrative expenses (other than personnel expenses) to total assets | BankScope |
| $w_3$ | Price of borrowed funds | Ratio of interest expenses to a sum of total deposits and other funding | BankScope |
| $D^{GF}$ | Foreign greenfield | Dummy variable that takes value of 1 for greenfield establishments of foreign banks | De Haas and Van Lelyveld (2006), Havrylchyk and Jurzyk (2008) |
| $D^{A}$ | Foreign acquired | Dummy variable that takes value of 1 for domestic banks acquired by a foreign bank | De Haas and Van Lelyveld (2006), Havrylchyk and Jurzyk (2008) and Thomson's SDC Platinum Database |
| $D^{FE}$ | Foreign entry | Dummy variable that takes value of 1 in the year when a domestic bank was taken over by a foreign bank | De Haas and Van Lelyveld (2006), Havrylchyk and Jurzyk (2008) and Thomson's SDC Platinum Database |
| $r_L$ | Implicit loan rate | Ratio of interest expenses to total loans | BankScope |
| $r_D$ | Implicit deposit rate | Ratio of interest expenses to total deposits | BankScope |
| $MC$ | Marginal costs | Derivative of the cost function obtained from the stochastic frontier model with respect to output quantity | BankScope and own estimations |
| $LLP$ | Loan-loss provisions | Ratio of loan-loss provisions to total loans | BankScope |
| $IMPL$ | Implicit interest revenue | Ratio of the net non-interest revenues to total assets | BankScope |
| $\rho$ | Reserve requirements ratio (%) | Bulgaria=8, the Czech Republic = 2, Estonia = 16, Croatia = 19, Hungary = 5, Latvia = 8, Lithuania = 6, Poland = 3.5, Romania = 20, Slovakia = 2, Slovenia = 2. | Barth et al. (2008) |
| $GDP$ | Economic activity | Annual real GDP growth | World Development Indicators (WorldBank) |
| $INFL$ | Inflation | Annual growth in consumer price index (CPI) | World Development Indicators (WorldBank) |
| $FX$ | Currency stability | Annual growth of average exchange rate *vis-a-vis* US dollar | International Financial Statistics (IMF) |

Table 3: Descriptive statistics

| | | **Bank costs** $C$ | **Earning assets** $L$ | **Price of labor** $w_1$ | **Price of capital** $w_2$ | **Price of borrowed funds** $w_3$ | **Loan rate** $i_L$ | **Deposit rate** $i_D$ | **Marginal costs** $MC$ | **Loan loss provisions** $LLP$ | **Implicit interest revenues** $IMPL$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Domestic banks | Mean | 748.6 | 17335.5 | 0.512 | 0.023 | 0.068 | 0.246 | 0.079 | 0.076 | 0.097 | 0.083 |
| | Median | 231.0 | 3959.8 | 0.524 | 0.020 | 0.054 | 0.189 | 0.066 | 0.068 | 0.060 | 0.072 |
| | St. Dev. | 1339.6 | 31630.5 | 0.201 | 0.012 | 0.045 | 0.186 | 0.052 | 0.035 | 0.106 | 0.040 |
| | Maximum | 9701.8 | 193000.0 | 0.849 | 0.071 | 0.324 | 1.847 | 0.336 | 0.225 | 1.000 | 0.310 |
| | Minimum | 13.7 | 145.0 | 0.042 | 0.004 | 0.011 | 0.066 | 0.012 | 0.012 | 0.000 | 0.014 |
| Foreign greenfield banks | Mean | 199.2 | 6311.4 | 0.585 | 0.014 | 0.053 | 0.265 | 0.061 | 0.049 | 0.019 | 0.054 |
| | Median | 104.3 | 4663.8 | 0.643 | 0.010 | 0.046 | 0.161 | 0.054 | 0.041 | 0.016 | 0.048 |
| | St. Dev. | 256.2 | 6560.5 | 0.194 | 0.010 | 0.037 | 0.367 | 0.045 | 0.027 | 0.016 | 0.027 |
| | Maximum | 1303.1 | 30823.7 | 0.838 | 0.049 | 0.244 | 2.309 | 0.305 | 0.148 | 0.075 | 0.171 |
| | Minimum | 14.8 | 218.1 | 0.095 | 0.004 | 0.011 | 0.054 | 0.013 | 0.014 | 0.000 | 0.019 |
| Foreign acquired banks | Mean | 1267.1 | 28641.7 | 0.556 | 0.018 | 0.046 | 0.171 | 0.053 | 0.066 | 0.073 | 0.064 |
| | Median | 473.3 | 13231.3 | 0.569 | 0.015 | 0.036 | 0.133 | 0.040 | 0.054 | 0.053 | 0.054 |
| | St. Dev. | 2388.1 | 43985.1 | 0.173 | 0.010 | 0.035 | 0.111 | 0.043 | 0.034 | 0.076 | 0.030 |
| | Maximum | 21324.9 | 193000.0 | 0.845 | 0.072 | 0.214 | 0.605 | 0.288 | 0.191 | 0.361 | 0.185 |
| | Minimum | 18.1 | 340.0 | 0.194 | 0.006 | 0.012 | 0.050 | 0.013 | 0.021 | 0.000 | 0.024 |
| Total (all banks) | Mean | 793.0 | 18371.3 | 0.524 | 0.021 | 0.063 | 0.235 | 0.074 | 0.072 | 0.088 | 0.078 |
| | Median | 235.9 | 4583.6 | 0.540 | 0.019 | 0.050 | 0.179 | 0.060 | 0.064 | 0.054 | 0.067 |
| | St. Dev. | 1536.0 | 33298.8 | 0.198 | 0.012 | 0.044 | 0.197 | 0.051 | 0.035 | 0.100 | 0.039 |
| | Maximum | 21324.9 | 193000.0 | 0.849 | 0.072 | 0.324 | 2.309 | 0.336 | 0.225 | 1.000 | 0.310 |
| | Minimum | 13.7 | 145.0 | 0.042 | 0.004 | 0.011 | 0.050 | 0.012 | 0.012 | 0.000 | 0.014 |

Note: All variables are measured in thousands of US dollars and deflated by the consumer price index, using 1995 as a reference year. To confront the influence of extreme observations and reporting errors, all variables have been winsorized at the $1^{st}$ and $99^{th}$ percentiles.

Table 4: Impact of foreign bank participation on cost efficiency: stochastic efficiency frontier model

| | (I) | (II) | (III) | (IV) | (V) | (VI) | (VII) |
|---|---|---|---|---|---|---|---|
| **Frontier** | | | | | | | |
| Earning assets | 0.5583*** | 0.5661*** | 0.5579*** | 0.5635*** | 0.5636*** | 0.5912*** | 0.6480*** |
| Price of labor/Price of capital | 0.5484*** | 0.5544*** | 0.5487*** | 0.5561*** | 0.5457*** | 0.5756*** | 0.5733*** |
| Price of borrowed funds/Price of capital | -0.0751 | -0.0774 | -0.075 | -0.0772 | -0.078 | -0.1182 | -0.2028** |
| Time trend | 0.0028 | -0.0009 | 0.0026 | -0.0018 | -0.0222 | -0.0087 | -0.0068 |
| (Earning assets)$^2$ | 0.0438*** | 0.0423*** | 0.0439*** | 0.0425*** | 0.0444*** | 0.0426*** | 0.0332** |
| (Earning assets)*(Price of labor/Price of capital) | -0.0009 | -0.0008 | -0.001 | -0.001 | -0.0019 | 0.0004 | 0.002 |
| (Earning assets)*(Price of borrowed funds/Price of capital) | 0.0095 | 0.0104 | 0.0095 | 0.0103 | 0.0078 | 0.0104 | 0.0169 |
| (Earning assets)*(Time trend) | 0.0043** | 0.0044** | 0.0043** | 0.0045** | 0.0042** | 0.0025 | 0.0035 |
| (Price of labor/Price of capital)$^2$ | -0.0327*** | -0.0340*** | -0.0327*** | -0.0338*** | -0.0357*** | -0.0516*** | -0.0552*** |
| (Price of labor/Price of capital)*(Price of borrowed funds/Price of capital) | 0.0210** | 0.0205** | 0.0210** | 0.0204** | 0.0273** | 0.0350*** | 0.0390** |
| (Price of labor/Price of capital)*(Time trend) | -0.0177*** | -0.0175*** | -0.0178*** | -0.0176*** | -0.0160*** | -0.0150*** | -0.0138*** |
| (Price of borrowed funds/Price of capital)$^2$ | -0.0583** | -0.0602*** | -0.0582** | -0.0598** | -0.0655*** | -0.0742*** | -0.0729** |
| (Time trend)$^2$ | 0.0006 | 0.0007 | 0.0006 | 0.0007 | 0.0012 | 0.0008 | -0.0006 |
| Constant | 1.3176*** | 1.2953*** | 1.3193*** | 1.3050*** | 1.4700*** | 1.5039*** | 0.9721** |
| **Inefficiency determinants** | | | | | | | |
| Time trend | -0.0290** | -0.0250** | -0.0287** | -0.0237* | | | |
| Foreign greenfield | | -0.3727*** | | -0.3786*** | | | |
| Foreign acquired | | | -0.005 | -0.0275 | | | |
| Foreign entry | | | | | 0.3190*** | | |
| Foreign entry (1 year lag) | | | | | | -0.3232** | |
| Foreign entry (2 years lag) | | | | | | | -0.0701 |
| Constant | -0.4256*** | -0.3421** | -0.4358*** | -0.4036 | -0.7732*** | -0.7779*** | -0.8076*** |
| **Statistics** | | | | | | | |
| Number of observations | 2,067 | 2,067 | 2,067 | 2,067 | 2,067 | 1,613 | 1,290 |
| Number of parameters | 40 | 41 | 41 | 42 | 40 | 39 | 38 |
| Log likelihood | -174.4958 | -168.9294 | -174.4923 | -168.8235 | -165.812 | -52.6434 | -64.6417 |
| $\log(\sigma_u^2)$ | -0.4128 | -0.5215 | -0.3929 | -0.4018 | -0.1867 | -0.3858 | -0.2521 |
| $\log(\sigma_v^2)$ | -2.9981*** | -2.9965*** | -2.9982*** | -2.9974*** | -3.0042*** | -3.1017*** | -3.0930*** |

Note: The dependent variable is the ratio of total operating expenses to the price of capital. All variables (except from the time trend) are expressed in the logarithmic form. Estimations are performed using maximum likelihood method based on the BFGS optimization algorithm. $\sigma_u^2$ and $\sigma_v^2$ stand for the standard deviation of the inefficiency and random error terms, respectively. Each specification also contains dummy variables for countries and time (not shown in the table to conserve the space). *, **, and *** denote significance at the 10 percent, 5 percent and 1 percent level, respectively.

Table 5: Impact of foreign bank participation on market power

| | (I) | (II) | (III) | (IV) | (V) | (VI) | (VII) |
|---|---|---|---|---|---|---|---|
| **Model** | | | | | | | |
| Deposit rate | 2.1462*** | 2.1571*** | 2.1270*** | 2.1364*** | 2.0572*** | 1.8219*** | 1.6451*** |
| Marginal costs | 0.4856** | 0.4843** | 0.4852** | 0.4840** | 0.2339* | 0.2350* | 0.3869* |
| Interaction term (deposit rate and foreign greenfield dummy) | | -0.0587 | | -0.0508 | 0.4651 | 0.1334 | 0.0771 |
| Interaction term (deposit rate and foreign acquired dummy) | | | -0.6900** | -0.6897** | -0.3720** | -0.4535** | -0.6361** |
| Non-performing loans | | | | | 0.1487** | | |
| Implicit interest revenue | | | | | | 1.2013*** | |
| Real GDP growth | | | | | | | -0.0044 |
| CPI inflation | | | | | | | 0.0008 |
| Exchange rate changes | | | | | | | 0.0018* |
| Constant | 0.0455* | 0.0456* | 0.0531* | 0.0532* | 0.0532* | 0.0015* | 0.0968*** |
| **Market power test** | | | | | | | |
| H0: Deposit rate coefficient = 1 | 10.22 | 9.32 | 9.54 | 8.66 | 5.78 | 6.87 | 3.31 |
| (p-value) | 0.0095 | 0.0122 | 0.0115 | 0.0147 | 0.0371 | 0.0256 | 0.0987 |
| H0: Deposit rate coefficient + Interaction term (deposit rate and foreign acquired dummy) = 1 | – | – | 1.03 | 1.17 | 2.38 | 1.72 | 0.00 |
| (p-value) | – | – | 0.3341 | 0.3053 | 0.1543 | 0.2187 | 0.9796 |
| **Statistics** | | | | | | | |
| Number of observations | 1,988 | 1,988 | 1,988 | 1,988 | 1,615 | 1,988 | 1,966 |
| $R^2$ | 0.2178 | 0.2172 | 0.2245 | 0.2241 | 0.2493 | 0.2555 | 0.2668 |
| Log-likelihood | 1305.8 | 1305.9 | 1314.4 | 1314.4 | 1202.8 | 1381.1 | 1347.8 |
| Panel autocorrelation test (p-value) | 0.1539 | 0.1948 | 0.1398 | 0.2436 | 0.1743 | 0.2195 | 0.1298 |

Note: The dependent variable is the ratio of total interest expenses to total loans. Estimations are performed using fixed effects OLS regression method with bootsrapped standard errors using 2000 replications. Standard errors are estimated using residuals clustered by country to allow for possible interdependence between banks located in the same country. Panel autocorrelation test (null hypothesis: no first order autocorrelation) is based on the procedure of Drukker (2003). Market power hypotheses are tested using Wald test statistic. *, **, and *** denote significance at the 10 percent, 5 percent and 1 percent level, respectively.

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